INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

CIVIL ENGINEERING

COURSE DESCRIPTOR

Course Title	**CONCRETE TECHNOLOGY**				
Course Code	ACE010				
Programme	B.Tech				
Semester	V	CE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	3	2
Chief Coordinator	Mr. N Venkat Rao, Associate Professor				
Course Faculty	Mr. N Venkat Rao, Associate Professor Mrs. B.Bhavani, Assistant Professor				

I. COURSE OVERVIEW:

Concrete technology provides a comprehensive coverage of the theoretical and practical aspects of the subject and includes the latest developments in the field of concrete construction. It incorporates the latest Indian standard specifications and codes regulating concrete construction. The properties of concrete and it constituent materials and the role of various admixtures in modifying these properties to suit specific requirements, such as ready mix concrete, reinforcement detailing, disaster-resistant construction, and concrete machinery have been treated exhaustively the and also special concrete in addition to the durability maintenance and quality control of concrete structure.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	ACE007	IV	Building Material Construction and Planning	4

III. MARKSDISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Concrete Technology	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✘	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✔	Mini Project	✔	Videos
✘	Open Ended Experiments						

V. EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

Semester End Examination (SEE):

The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into five modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

The emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
50 %	To test the analytical skill of the concept OR to test the application skill of the concept.

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 20 marks for Continuous Internal Examination (CIE), 05 marks for Quiz and 05 marks for Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz / AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):

Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz / Alternative Assessment Tool (AAT):

Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	2	Presentation on real-world problems
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	1	Assignments
PO3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	2	Mini Project
PO 4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	2	Seminars
PO 5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations	1	Assignments

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Engineering knowledge:** Graduates shall demonstrate sound knowledge in analysis, design, laboratory investigations and construction aspects of civil engineering infrastructure, along with good foundation in mathematics, basic sciences and technical communication	2	Assignments
PSO 2	**Broadness and Diversity:** Graduates will have a broad understanding of economical, environmental, societal, health and safety factors involved in infrastructural development, and shall demonstrate ability to function within multidisciplinary teams with competence in modern tool usage.	1	Seminars
PSO 3	**Self-learning and Service:** Graduates will be motivated for continuous self-learning in engineering practice and/ or pursue research in advanced areas of civil engineering in order to offer engineering services to the society, ethically and responsibly.	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES :

The course should enable the students to:	
I	Discuss the physical and chemical properties of cement and admixtures.
II	Understand the workability of concrete, manufacturing processes of concrete and the behavior of the hardened concrete.
III	Identify, formulate and solve problems in concrete mix design.
IV	Enrich the practical knowledge on mix design principles, concepts and methods

IX. COURSE OUTCOMES (COs):

COs	Course Outcome	CLOs	Course Learning Outcome
CO 1	Understand the basic physical and chemical properties of cement, admixtures and aggregates	CLO 1	Explain the different types of cement, grades of cement and hydration process.
		CLO 2	Classify different types of admixture and their usage.
		CLO 3	Understand aggregates and classification of aggregate depending upon shape, size, texture etc.
		CLO 4	Understand the Alkali Aggregate Reaction.
		CLO 5	Understand Sieve Analysis and grading of aggregate.
CO 2	Describe the properties and factors influencing the workability of fresh concrete	CLO 6	Understand the concept of workability of concrete and factors affecting workability.
		CLO 7	Explain the measurement of workability by different test.
		CLO 8	Understand the concept of segregation and bleeding in concrete.

COs	Course Outcome	CLOs	Course Learning Outcome
		CLO 9	Explain the various steps involved in the manufacturing process of concrete.
		CLO 10	Understand the importance of quality of mixing water.
CO 3	Determine the affect of water/cement ratio on the strength of hardened concrete and also the strength of concrete by using NDT testing methods	CLO 11	Understand hardened concrete and its properties.
		CLO 12	Explain the importance of water cement ratio, maturity concept in hardened concrete
		CLO 13	Understand the various methods of curing of concrete.
		CLO 14	Explain the different tests involved in testing of hardened concrete.
		CLO 15	Understand the concept of creep and how it effects hardened concrete.
		CLO 16	Explain shrinkage and its effect on concrete.
CO 4	Analyse the mix design of concrete	CLO 17	Understand the importance of Mix proportions.
		CLO 18	Understand durability and quality control of concrete.
		CLO 19	Explain Acceptance criteria involved in concrete mix proportioning.
		CLO 20	Explain proportioning of concrete method by different methods.
		CLO 21	Design the concrete mix by BIS method.
CO 5	Understand the basic concepts and applications of special concretes at various situations	CLO 22	Explain the different types of special concrete.
		CLO 23	Explain the effect of fiber in the concrete.
		CLO 24	Understand the performance of fibers on concrete
		CLO 25	Explain the tests involved in self-compacting concrete

X. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
ACE010.01	CLO 1	Explain the different types of cement, grades of cement and hydration process.	PO1, PO3	2
ACE010.02	CLO 2	Classify different types of admixture and their usage.	PO2, PO5	1
ACE010.03	CLO 3	Understand aggregates and classification of aggregate depending upon shape, size, texture etc.	PO1, PO3	2
ACE010.04	CLO 4	Understand the Alkali Aggregate Reaction.	PO1, PO4	2
ACE010.05	CLO 5	Understand Sieve Analysis and grading of aggregate.	PO2, PO3 PO5	2
ACE010.06	CLO 6	Understand the concept of workability of concrete and factors affecting workability.	PO1;PO2; PO4	2
ACE010.07	CLO 7	Explain the measurement of workability by different test.	PO3	2
ACE010.08	CLO 8	Understand the concept of segregation and bleeding in concrete.	PO1,PO4, PO5	2

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
ACE010.09	CLO 9	Explain the various steps involved in the manufacturing process of concrete.	PO3	2
ACE010.10	CLO 10	Understand the importance of quality of mixing water.	PO2, PO3	2
ACE010.11	CLO 11	Understand hardened concrete and its properties.	PO2, PO4, PO5	1
ACE010.12	CLO 12	Explain the importance of water cement ratio, maturity concept in hardened concrete	PO1	2
ACE010.13	CLO 13	Understand the various methods of curing of concrete.	PO1, PO2, PO3, PO5	2
ACE010.14	CLO 14	Explain the different tests involved in testing of hardened concrete.	PO2	1
ACE010.15	CLO 15	Understand the concept of creep and how it effects hardened concrete.	PO2, PO3, PO5	1
ACE010.16	CLO 16	Explain shrinkage and its effect on concrete.	PO1, PO4	2
ACE010.17	CLO 17	Understand the importance of Mix proportions.	PO2, PO3	2
ACE010.18	CLO 18	Understand durability and quality control of concrete.	PO2, PO5	1
ACE010.19	CLO 19	Explain Acceptance criteria involved in concrete mix proportioning.	PO2, PO3, PO4	2
ACE010.20	CLO 20	Explain proportioning of concrete method by different methods.	PO1	2
ACE010.21	CLO 21	Design the concrete mix by BIS method.	PO2, PO3, PO4, PO5	2
ACE010.22	CLO 22	Explain the different types of special concrete.	PO1	2
ACE010.23	CLO 23	Explain the effect of fibre in the concrete.	PO1, PO4	2
ACE010.24	CLO 24	Understand the performance of fibres on concrete	PO2,PO4	2
ACE010.25	CLO 25	Explain the tests involved in self-compacting concrete	PO 3,PO5	2

3= High; 2 = Medium; 1 = Low

XI. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES:

Course Outcomes (COs)	Program Outcomes (POs)						
	PO 1	PO 2	PO 3	PO 4	PO 5	PSO1	PSO2
CO 1	2	2	3	3	2	2	1
CO 2	2	1	2	3	1	1	2
CO 3	2	2	2	3	2	2	1
CO 4	3	2	2	2	2	2	2
CO 5	3	2		2	1	1	2

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XII. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Learning Outcomes (CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	2		2											2	
CLO 2		1			1								2		
CLO 3	2		2											1	
CLO 4	2			2										1	
CLO 5		2	2		2								2		
CLO 6	2	2		2										2	
CLO 7			2											1	
CLO 8	2			2	2								1		
CLO 9			2											2	
CLO 10		2	2											2	
CLO 11		1		1	1								2		
CLO 12	2														
CLO 13	2	2	2		2										
CLO 14		1													
CLO 15		1	1		1								2		
CLO 16	2			2										1	
CLO 17		2	2											2	
CLO 18		1			1									2	
CLO 19		2	2	2									2		
CLO 20	2													1	
CLO 21		2	2	2	2										
CLO 22	2													2	
CLO 23	2			2									1		
CLO 24		2		2											
CLO 25			2		2										

3 = High; 2 = Medium; 1 = Low

XIII. ASSESSMENT METHODOLOGIES–DIRECT

CIE Exams	PO 1; PO2; PO5,PSO1, PSO2	SEE Exams	PO 1; PO2; PO5 PSO1, PSO2	Assignments	PO 2	Seminars	PO 3
Laboratory Practices	PO 5	Student Viva	-	Mini Project	PO 4;PO5	Certification	-
Term Paper	-						

XIV. ASSESSMENT METHODOLOGIES-INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XV. SYLLABUS

UNIT-I	**CEMENT ADMIXTURES AND AGGREGATES**
Portland cement :chemical composition , hydration, setting of cement , structure of hydrate cement , test on physical properties , different grades of cement Admixtures: Mineral and chemical admixtures, properties, dosage, effects usage. Aggregates: Classification of aggregate, particle shape & texture bond, strength & other mechanical properties of aggregate, specific gravity, bulk density, porosity, adsorption & moisture content of aggregate, bulking of sand, deleterious substance in aggregate, soundness of aggregate , alkali aggregate reaction, thermal properties, sieve analysis, fineness modulus, grading curves, grading of fine & coarse aggregates, gap graded aggregate, maximum aggregate size.	
UNIT -II	**FRESH CONCRETE**
Workability :factors affecting workability , measurement of workability by different tests, setting times of concrete, effect of time and temperature on workability, segregation & bleeding, mixing and vibration of concrete, steps in manufacture of concrete, quality of mixing water.	
UNIT -III	**HARDENED CONCRETE AND ITS TESTING**
Water / Cement ratio: Abram's Law, Gel space ratio, Nature of strength of concrete, Maturity concept, Strength in tension & compression, factors affecting strength, relation between compression & tensile strength curing. Testing of hardened concrete: compression tests, tension tests, factors affecting strength, flexure tests, splitting tests, non-destructive testing methods, codal provisions for NDT. elasticity, creep & shrinkage, modulus of elasticity, dynamic modulus of elasticity, Poisson's ratio, creep of concrete, factors influencing creep, relation between creep & time, nature of creep, effects of creep, shrinkage, types of shrinkage.	
UNIT -IV	**MIX DESIGN**
Factors in the choice of mix proportions, Durability of concrete, Quality Control of concrete, Statistical methods, Acceptance criteria, Proportioning of concrete mixes by various methods, BIS method of mix design	
UNIT -V	**SPECIAL CONCRETE**
Light weight aggregates, light weight aggregate concrete, cellular concrete , no fines concrete, high density concrete, fiber reinforced concrete, different types of fibers , factors affecting properties of F.R.C, applications, polymer concrete, types of polymer concrete, properties of polymer concrete applications, high performance concrete, self-consolidating concrete, SIFCON	

Text Books:
1. Shetty, M.S., "Concrete Technology, Theory & Practice", S. Chand and Co, 2004. 2. Gambhir, M.L., "Concrete Technology", Tata McGraw Hill, 2004.
Reference Books:
1. V.N.Vazirani&S.P.Chandola, Ed. by Vineet Kumar," Concrete technology", 6th edition reprint. 2. Santakumar A.R., "Concrete Technology", Oxford University Press, New Delhi, 2007..

XVI. COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1-2	Introduction to Portland cement :chemical composition	CLO 1	T1: 1.1-1.7
3	Hydration, setting of cement	CLO 1	T1: 1.8-1.9 T1: 2.28-2.28.2
4	Structure of hydrate cement,	CLO 1	T1: 1.13-1.14
5	Test on physical properties Different grades of cement	CLO 1	T1:2.1-2.6 T1: 2.18
6	Admixtures: Mineral and chemical admixtures	CLO 2	T1: 5.1-5.3
7	Properties, dosage, effects usage of admixtures	CLO 2	T1: 5.4-5.5
8	Aggregates: Classification of aggregate, particle shape & texture bond	CLO 3	T1: 3.2-3.4
9	Strength & other mechanical properties of aggregate	CLO 3	T1: 3.7-3.9
10	Specific gravity, bulk density, porosity, adsorption & moisture content of aggregate	CLO 3	T1: 3.15-3.18
11	Bulking of sand, Deleterious substance in aggregate, Soundness of aggregate	CLO 3	T1: 3.26-3.27 T1: 3.19-3.20 T2 :3.50
12	Alkali aggregate reaction, thermal properties	CLO 4	T2 :3.6-3.7
13	Sieve analysis, fineness modulus	CLO 5	T2:3.8-3.9
14-16	Grading curves, grading of fine & coarse aggregates, gap graded aggregate, maximum aggregate size	CLO 5	T2:3.9-3.11
17-18	Introduction to Workability of concrete :factors affecting workability	CLO 6	T2: 6.1-6.4
19-21	Measurement of workability by different tests	CLO 7	T1:6.3-6.36
22-23	Setting times of concrete	CLO 7	T1:6.6
24	Effect of time and temperature on workability	CLO 7	T1: 6.6
25-26	Segregation & bleeding	CLO 8	T1: 6.4-6.5
27-28	Mixing and vibration of concrete	CLO 8	T1: 6.7.1-6.7.7.15
29-30	Steps in manufacture of concrete	CLO 9	T1: 6.7-6.8
31	Quality of mixing water	CLO 10	T1: 4.2-4.3
32	Introduction to Hardened concrete: Water / Cement ratio, Abram's Law	CLO 12	T1: 7.2
33	Gel space ratio	CLO 12	T1: 7.3
34	Nature of strength of concrete	CLO 12	T1: 7.4
35	Maturity concept of concrete	CLO 12	T1: 7.6
36-37	Strength in tension & compression	CLO 11	T1: 7.8
38	Factors affecting strength	CLO 11	T1: 7.7
39	Relation between compression & tensile strength, curing	CLO 13	T1: 7.8 T1: 6.8-6.9
40	Testing of hardened concrete: Compression tests, tension tests	CLO 14	T1: 10.1-10.2
41	Factors affecting strength, flexure tests,	CLO 14	T1:10.7-10.9
42	Splitting tests, non-destructive testing methods, codal	CLO 14	T1:10.8-10.11

	provisions for NDT		
43	Elasticity, creep & shrinkage	CLO 15	T1:8.1-8.3
44	Modulus of elasticity, dynamic modulus of elasticity, Poisson's ratio	CLO 15	T1:8.1.1-8.1.4
45-46	Creep of concrete, factors influencing creep, relation between creep & time, nature of creep, effects of creep	CLO 15	T1:8.2
47	Shrinkage ,types of shrinkage	CLO 16	T1:8.3
48-49	Introduction to Mix design: Factors in the choice of mix proportions	CLO 17	T1:11.3
50-51	Durability of concrete	CLO 18	T1:9.2
52-53	Quality control of Concrete.	CLO 18	T1:11.5
54-55	Statistical methods, Acceptance criteria	CLO 19	T1:11.5-11.7
56	Proportioning of concrete mixes by various methods	CLO 20	T1:11.9
57-59	BIS method of mix design	CLO 21	T1:11.13
60-62	Exercise problems on Mix design	CLO 21	T1:11.13-11.14
63-64	Light weight aggregates, light weight aggregate concrete	CLO 22	T2:14.2-14.3
65-66	Cellular concrete , no fines concrete	CLO 22	T2:14.15
67	High density concrete	CLO 22	T1:12.8
68-69	Fiber reinforced concrete, different types of fibers	CLO 23	T1:12.10
70-71	Factors affecting properties of F.R.C, applications	CLO 23	T1:12.10.2
72-73	Polymer concrete, types of polymer concrete	CLO 22	T1:12.13
74	Properties of polymer concrete applications	CLO 22	T1:12.13.2
75	High performance concrete	CLO 22	T2:16.1-16.9
76	Self-consolidating concrete	CLO 22	T1:13.1-13.4
77	Slurry infiltrated fibre concrete (SIFCON)	CLO 22	T2:14.2

XVII. GAPS IN THE SYLLABUS-TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed Actions	Relevance With PO's	Relevance With PSO's
1	Design a concrete mix for lower grade concrete using BIS	Seminars	PO 1	PSO 1
2	Design a concrete mix for higher grade concrete using BIS	Seminars / NPTEL	PO 5	PSO 1

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